Crafting Firm Competencies to Improve Innovative Performance

European Management Journal (2009) 27, 187–196

journal homepage: www.elsevier.com/locate/emj

Crafting firm competencies to improve innovative performance

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KEYWORDS
Firm competencies;
Radical and incremental product innovation;
Team cohesiveness

Summary Recent interdisciplinary research suggests that customer and technological competencies have a direct, unconditional effect on firms' innovative performance. This study extends this stream of literature by considering the effect of organizational competencies. Results from a survey-research executed in the fast moving consumer goods industry suggest that firms that craft organizational competencies – such as improving team cohesiveness and providing slack time to foster creativity – do not directly improve their innovative performance. However, those firms that successfully combine customer, technological and organizational competencies will create more innovations that are new to the market.

Introduction

Management researchers have recognized that companies gain and sustain competitive advantage due to the ability to renew, integrate and expand their existing competencies and continuously develop new capabilities (Teece *et al.*, 1997). Product innovation has been viewed in this context as an important mechanism through which organizations modify and establish competencies that are central for staying competitive within the fast-changing business environment (Danneels, 2002; Dougherty, 1992). The ability to develop new products has been labeled a 'dynamic capability' as it helps organizations to modify resource arrangements within a company and to react to environmental changes (Eisenhardt and Martin, 2000; Teece *et al.*, 1997). However, this influence works both ways.

Current interdisciplinary research suggests that to innovate successfully companies have to possess key competencies relating to technology and customers (Belderbos *et al.*, 2004; Danneels, 2002; Griffin and Hauser, 1992). Moreover, it has proposed that a successful integration of competencies allows companies to outperform their competitors because such interaction increases firm efficiency (Walker and Ruekert, 1987) and inhibits imitation by rivals (Reed and DeFillippi, 1990). Most of the past research on complementarities has focused on establishing synergetic effects between customer/marketing and technological firm capabilities. Duta *et al.* (1999) argue that complementarity between customer and technological competence is the most significant single determinant of firm superior financial performance in high-technology markets. Moorman and

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0263-2373/$ - see front matter
doi:10.1016/j.emj.2008.08.005

Slotegraaf (1999) find that firms that combine technological and marketing competencies are more likely to make faster improvements to their products compared to their rivals. Song *et al*. (2005) investigate complementarity between marketing and technological competencies in different environmental contexts using a sample of 466 firms and conclude that these competencies are synergetic in high-turbulence business environment only, resulting in higher firm performance.

There is another strand of literature (e.g., Trott, 2005; Tidd *et al.*, 2005) that emphasizes the value of organizational mechanisms that can explain sustained performance differences among firms (Teece, 1980). Surprisingly, the above two research streams (customer, technological link to innovation and organizational link to innovation) have evolved independently from one another with little empirical evidence on the effect of organizational competencies on firm innovative performance.

In this article we propose to integrate the two perspectives by focusing on the mediating effect of organizational competencies on firm effective product innovation, conditional on the presence of customer and technological competencies. We predict that the presence of specific organizational practices, such as team cohesiveness and slack time, exert a positive effect on firm innovation performance and that their interaction with customer and technological competencies has a synergetic effect in that those firms that combine these organizational competencies with customer and technological competencies are more successful in coming up with new innovations compared to their rivals.

The accumulated previous research describes the relationship between firm competencies and product innovation, mainly in the high-tech industry. This type of industry usually involves the manufacturing of business-to-business products. Less attention has been spent on the question of whether these findings also apply in business-to-customer environments. Furthermore, existing research has been discussing product innovation in general, while contributions differentiating between degrees of novelty, such as radical and incremental product innovation are lacking. It has been recognized that it is foremost radical innovation that is crucial for firm survival in the fast changing business environment (Danneels, 2002). We analyze the effect of competencies on both radical and incremental innovation.

Literature review

In the literature review part we first discuss the literature on customer, technological and organizational competencies and their impact on innovation. Based on this overview, the research proposition of this paper is developed.

Customer competencies

Customer competence, stemming from the marketing concept that puts customer needs first, has often been regarded as fundamental in helping firms achieve their performance goals through positioning of its brands relative to competing brands (Deshpande *et al.*, 1993; Gentile *et al.*, 2007). Literature in the strategic management and industrial organization field emphasizes the importance of knowledge sourced from customers for firms' innovative performance (Contractor and Lorange, 2002). Customer competence can reduce the risks associated with the market introduction of innovations (Hargadon and Douglas, 2001; Hippel, 1988). In particular, when products are novel and complex and hence require adaptations in the use by customers, engagement with customers may be essential to ensure market expansion (Sawhney *et al.*, 2005; Tether, 2002). An effective way for an organization to enhance its customer competence is through active collaboration with its customers (e.g. in development and testing of new products, obtaining high-quality customer feedback, 'user tool kit') which allows maintaining stronger relationship with customers, better understanding of their needs and simultaneously raising their acceptance level toward a new product. A firm can potentially reduce the risks involved with commercializing of an innovation, increasing the probability that the new product will be accepted by other firms, which in turn can lead to a new standard (Thomke and Hippel, 2002).

Technological competencies

Technological competence refers to firm's ability to generate, as well as assimilate, transform and exploit the acquired knowledge (Zahra and George, 2002). Technological competencies are crucial for successful innovative performance of firms in the consumer goods industry because they operate in markets characterized by short product life-cycles and high rates of new product introductions. Previous research has identified a key role to the firm's own R&D activities in creating firms' technological competencies (Cohen and Levinthal, 1990), as that in turn facilitates acquisition and assimilation of external knowledge. Technological development within a firm can be influenced to a greater extent by a firm's ability to externally source knowledge. Such sourcing often may be from outside the supply chain, e.g. from competitors, universities, or research institutes (Belderbos *et al.*, 2004). Companies often learn by monitoring technology and market developments. In doing so, they strive to acquire and implement new ideas by learning from partners and by screening technology and market developments (Hamel, 1991). A number of recent papers (e.g. Fritsch and Lukas, 2001; Katz *et al.*, 1995) point out that in order to quickly identify and exploit external knowledge, it is essential to employ a 'gatekeeper' to continuously monitor the company's environment. Gatekeepers can translate technical knowledge into terms meaningful to managers and their presence in the organization has been found to positively correlate with performance of development projects (Katz *et al.*, 1995). In addition to monitoring changes in technological resources, firms now realize that customer awareness of product quality became their 'primary purchasing standard' (Feigenbaum, 1996: p. 8) compelling firms in addition to external technological developments, to continuously monitor the quality of its own products and processes.

Organizational competencies

When firm-specific assets are assembled in integrated clusters spanning individuals and groups so that they enable distinctive activities to be performed, these activities constitute organizational routines or competencies (Teece *et al.*, 1997: p. 516). Organizational competence affects firm performance and can explain sustained performance differences among firms due to slow diffusion of best practices and difficulties in imitation of complex organizational capabilities (e.g., Teece, 1980; Trott, 2005; Tidd *et al.*, 2005). According to Trott (2005), there are specific requirements to support organization's innovativeness such as an orientation towards long-term profits, the ability to identify threats and opportunities, acceptance of risk, uncertainty and change, teamwork using a diverse range of skills, 'slack', receptivity, and a strong commitment to technological development. In this article we focus on two of these organizational practices that have been identified in previous research as important in fostering firm innovativeness.

A first decisive characteristic of a successful innovative organization is the ability to build and maintain *team cohesiveness*. For teamwork to succeed, Hoegl and Gemuenden (2001) emphasize the need for team cohesion and commitment, existence of an open level of communication between team members, good coordination of tasks, member contribution corresponding to personal knowledge, and mutual support within the team. An effective way to achieve team cohesiveness and productive cooperation among its members is through structural implementation of a heavy-weight project team, embedded within what is referred to as the 'project matrix' (Clark and Wheelwright, 1992; Larson and Gobeli, 1988). In a heavy-weight project team all team-members are from different departments and are controlled by a heavy-weight project manager who has a primary influence over individuals working in the project, directly supervising their work and evaluating each member's contribution. In contrast to an autonomous team structure, the team members are connected to their functional manager, who decides on their long-term career development given that team members are not permanent members of the team. The advantage of such a team structure is that the project manager, in making key decisions, facilitates across functions to improve the flow of communication, thus spurring successful innovations within a firm as well as a higher degree of commitment towards the project (Angle, 1989; Ancona and Caldwell, 1997).

The second organizational competence studied is *slack time*. It has been recognized that to enable ongoing generation of new ideas managers need to promote business creativity in their organizations (Amabile, 1998). In order to be able to work on projects successfully and creatively employees need a certain amount of autonomy in their daily processes. Slack time is one of the most effective tools managers can use to foster employees' creativity. This can enhance individuals' motivation, reducing the number of situations that can lead to employees leaving an organization to start up their own business (Gomez-Mejia *et al.*, 1990). Firms can even choose to structure time for creative project employees (Perlow, 1999). Employees of Google, for example, — the world leading internet search engine — have 20 per cent of their working time to their own disposal allowing engagement in projects they choose themselves (Wirtschaftswoche, 2006). Other successful organizations, such as 3M have similar procedures. The slack time allows employees to have 'room to think, experiment, discuss ideas and be creative' (Trott, 2005: p. 85). Slack can help strike a balance between effectively managing the firm's daily business which requires formal rules and procedures and being innovative which requires for example, a loose and open communication system.

So far, we have discussed the importance of the three types of competencies separately. However, in addition to directly affecting firm innovative performance, firm competencies can serve as important complements to each other enhancing their effectiveness and driving the firm's competitive advantage. In light of the reviewed literature we argue that product innovation requires combining firm competencies relating to technology, customers and organization. We hypothesize that the innovation process is likely to be the most effective and most efficient when organizational competencies are brought together with customer and technological competencies.

We propose that:

The sucess of customer and technological competencies in positively affecting firm innovative output is enhanced by the presence of organizational competencies, i.e. product innovation is most effective when technological, customer and organizational competencies are combined.

Research design

Sample

The empirical analysis uses data collected through a structured questionnaire administered at the beginning of 2006. Our sampling consisted of the entire population of firms in the fast-moving consumer goods (FMCG) industry in Germany. The FMCG industry was selected, because rapid innovations are essential for firm survival in this industry. The increased speed of development of new technology as well as the growing expectations of consumers has made the consumer goods industry highly customer-oriented, which makes it an attractive choice when testing importance of customer competencies. A high level of competition and hardly growing demand make the ability to innovate increasingly important for companies to stay competitive. The analysis was conducted in one country only, because the comparison of responses is facilitated as long as all participants underlie the same general conditions. To the best of our knowledge and based on different sources (e.g., Lebensmittel Zeitung, 2006; Consumergoods, 2005), there are 55 major companies operating in the German FMCG industry. FMCG can be grouped into beverage, food, pet supplies, tobacco, household supplies, baby care, cosmetics, dietary supplements, perfume, toiletries, and over-the-counter remedies (Nielsen NetRatings, 2006). However, some firms make several of these products.

The questionnaires were presented in German and were filled out in a combination of interviewer-administered telephone conversations and self-administered on-line questioning. In some cases employees from different departments answered the questionnaire since some questions were easier to be answered by a marketing manager and others by a human resource manager. A combination of interviewer-administered telephone questionnaire and self-administered on-line questionnaire enhances the reliability of the data because the researcher can better control that the desired person answers the survey (Saunders *et al.*, 2003). There are no mean differences on key variables for both data collection methods used. A total of 27 companies out of 55, equivalently 49%, answered the questionnaire. The response rate of 49% can be considered as relatively high. No significant differences were found between the participating and non-participating firms in terms of size category or industry subclass. These findings suggest that our sample was representative of the population.

Variables

The survey instrument consisted of two sections (see Appendix, Table A1), and investigated besides product innovation also the different firm competencies.

Dependent variables

Firm innovative performance

To capture firms' innovative performance we used two dependent variables: number of *successful product innovations* realized by the firm over the past two years, and whether a firm has *radical innovations* realized over the same period. We argue that radical innovations and incremental innovations are the two extremes on the continuum of the novelty degree of a product. This approach forces respondents to choose either one of two extremes of innovation output, instead of a more continuous distribution. In their framework on architectural innovation, Henderson and Clark (1990) consider what lies in between the two extremes. The authors discovered that even modular changes sometimes have an immense impact on competitive consequences. Therefore, they add the level of component and architectural innovation. For this study we limit ourselves only to the two extremes of the continuum of the novelty degree of a product. One of our aims when administering questionnaires was to present clear choices to the respondents which would allow maximizing the response rate. Our formulation of the question follows closely the one used in the bi-annual Community Innovation Surveys (CIS) administered by EUROSTAT to collect data on innovation in European firms. Our qualification of the importance of the innovation is derived from the economic point of view, by focusing on the implication of the innovation for the relevant markets (e.g., Abernathy and Clark, 1985). When administering the questionnaire we took care to make it clear to the respondents that incremental innovations include slight improvements of the existing products, and are not new to the market, whereas the output of a radical innovation is a product which is entirely new to the market.

Independent variables

Customer competencies

Based on previous research (Hippel, 1988; Thomke and Hippel, 2002; Tether, 2002; Sawhney *et al.*, 2005) four Likert-scale questions were developed to measure customer competencies.

Technological competencies

Five Likert-scale questions were used to measure the different subcomponents of technological competencies, based on the research projects of Katz *et al.* (1995), Feigenbaum (1996), Fritsch and Lukas (2001) and Belderbos *et al.* (2004).

Organizational competencies

The team structure and slack time questions result from the work of Clark and Wheelwright (1992), Amabile (1998) and Trott (2005).

Control variables

We controlled for *firm size* measured as the number of employees in 2004 as it might affect the firm performance. According to Fritsch and Lukas (2001) the company's size is important in the process of innovating, because larger companies have more external linkages to their customers, to partners and to other institutions and can thus better exploit their opportunities.

Method

Because of the small degrees of freedom in our model prior to running this regression we applied a factor analysis to combine the individual dimensions of each of the three competencies into an overall measure. The analysis reveals that in each case there is only one factor that can be identified. Likelihood-ratio test rejects the null of the presence of the second factor in each case. Each of the variables forming customer competencies loaded highly and unambiguously on the unique factor (customer cooperation, 0.74; market research, 0.69; customer sourcing, 0.65; customer meetings 0.64), accounting for 48% of the variance. All four variables relating to the technological competencies also load on a unique factor (technology acquisition, 0.88; industry monitoring, 0.82; quality control, 0.71; intellectual property, 0.59) accounting for 57% of the variance. Finally the team and slack variables clustered to one organizational competence variable (team, 0.84, slack, 0.85), explaining 71% of the variance in the sample.

Following an inspection of the descriptive statistics on the focal variables (see Table 1), regression models were estimated with total innovative performance and radical innovations as dependent variables and the constructs pertaining to competencies as explanatory variables.

Findings and implications

The average number of all successful product innovations is reasonably high with a mean of 2.33. Companies in the FMCG industry have significantly more incremental than radical innovations, namely 84% versus 16% on average (We refer to the Table A2 in the appendix for the descriptive statistics of the base variables). We conducted t-tests on the difference of means of the focal variables between the group of firms with a small number of innovations and the group with a relatively large number of innovations (Table A3 in the appendix). We found that the average means of the focal variables are statistically significantly higher for the group of firms with relatively large number of innovations. This finding suggests a positive influence of the variables measuring customer, technological and organizational competencies on product innovations. We also conducted t-tests on the same variables to check the differences between firms that introduced new products to the market and those that did not (Table A4 in the appendix). In the group of companies with radical innovations the means are statistically higher suggesting that to successfully produce radical innovations, higher level of firm competencies compared to incremental innovation are required.

The results of the regressions for radical and for all innovations are reported in Tables 2 and 3. These regressions reveal that our technological competence score variable is significant in both the radical and all innovation equation and the customer competence score variable is significant in the overall innovation equation. The organizational variable is not significant by itself in either of the equations. However, a key objective of this study is to examine the mediating effect of organizational practices on firm's innovative performance. In order to test the effect of combining practices, we created several cross-term variables by interacting customer, technological and organizational competencies pair-wise as well as creating a triple cross-term (customer, technological and organizational combined). We then run the regressions with this additional variable interaction terms. These results are presented in Tables 2 and 3. Several of the interaction terms are statistically significant. First, the results show that combining customer and technological competencies and technological and organizational competence can increase the overall innovative performance of firms. This finding seems to be consistent with the literature that indicates that firms that exploit synergies between customer/marketing and technological firm capabilities can outperform their rivals due to the increased efficiency. Second, the results also show that the three-way interaction term is positive and significant in the radical innovation equation, but not significant in incremental innovation equation. This finding provides evidence that those firms that combine organizational with customer and technological competencies are more successful in coming up with new innovations compared to their rivals.

Conclusions and future research

Previous studies that examined the relationship between firm competencies and innovative performance focused primarily on establishing synergies between customer/marketing and technological firm capabilities allowing companies to outperform rivals due to increased efficiency (Duta *et al.*, 1999; Moorman and Slotegraaf, 1999; Song *et al.*, 2005; Walker and Ruekert, 1987). This study examined the direct and mediating effect of organizational competencies on firm innovative performance. We argued that organizational competencies are an important co-determinant of innovative performance because they can explain sustained performance differences among firms due to slow diffusion of best practices and difficulties in imitation of organizational capabilities (Teece, 1980; Trott, 2005; Tidd *et al.*, 2005). In addition, our goal was to test whether there is a synergetic effect on product innovation of combining technological, customer and organizational competencies.

In summary, results of our study confirm our proposition, indicating a positive impact of constructs capturing customer, technological and organizational competencies on firm innovative performance as measured by the products novel to the market. The mean comparison tests suggest that a higher level of competencies are characteristic of firms with higher innovation output and that for radical innovation a higher level of firm competencies compared to incremental innovation is required. The results of the exploratory multivariate regression analysis, together with the simple mean comparisons tests, are suggestive of the mediating role played by the organizational competencies, indicating that combining competencies is especially crucial for radical innovation performance.

Our findings pertaining to the effects of organizational competencies suggest that these also matter for the innovation process. However, although team cohesiveness and slack time do increase a firm's radical innovation performance, they reduce the efficiency which might be needed for the more incremental innovations. This suggests that companies need different degrees of organizational competencies for radical and incremental product innovation. Firm managers have to decide how important both types of innovation are to their company, and based on this choice, decide on the importance of team work and slack time. Another solution could be that firms do set up a new venture department to develop radical innovations, and craft different organizational competencies within this specific department. In this way, no efficiency losses will occur in existing units involved in incremental research efforts.

Table 1 Correlations between the independent variables used in the regression analysis.

	Customer competence	Technological competence	Organizational competence	Firm size
Customer competence	1.00			
Technological competence	0.41	1.00		
Organizational competence	0.12	0.22	1.00	
Firm size	0.36	0.30	−0.09	1.00

Table 2 Radical innovations (new products to the market).

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Customer competence	1.43 (0.44)			1.25 (0.66)	1.08 (0.91)	1.64 (0.43)	1.46 (0.52)	1.56 (0.44)
Technological competence		8.05 (0.02)		8.38 (0.01)	26.87 (0.00)	11.25 (0.01)	10.38 (0.01)	11.38 (0.00)
Organizational competence			1.37 (0.47)	1.04 (0.94)	1.14 (0.82)	1.05 (0.92)	1.08 (0.89)	0.99 (0.99)
Customer competence X Technological competence					0.10 (0.01)			
Customer competence X Organizational competence						0.53 (0.41)		
Technological competence X Organizational competence							0.29 (0.17)	
Customer competence X Technological competence X Org. competence								0.44 (0.02)

Note: *p*-values are in parentheses. All regressions include control variable for firm size.

Table 3 All innovations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Customer competence	1.47 (0.09)			0.60 (0.49)	1.53 (0.11)	0.53 (0.56)	0.63 (0.41)	1.70 (0.04)
Technological competence		2.64 (0.01)		2.68 (0.01)	3.82 (0.00)	2.80 (0.01)	3.91 (0.00)	4.17 (0.00)
Organizational competence			−0.29 (0.80)	−0.98 (0.35)	−1.06 (0.30)	−0.96 (0.36)	−1.18 (0.22)	−0.93 (0.35)
Customer competence X Technological competence					1.31 (0.00)			
Customer competence X Organizational competence						0.51 (1.15)		
Technological competence X Organizational competence							2.25 (0.02)	
Customer competence X Technological competence X Org. competence								−1.70 (0.07)

Note: *p*-values are in parentheses. All regressions include control variable for firm size.

In order to improve the organizational competencies within a firm or a department, managers in first instance have to consider how to stimulate team work and team cohesiveness. Building teams requires finding the right blend of people in relation to the different skills required. Moreover, individual employees might need training to perform effectively as a team member or a manager of the team process. Good communication, conflict management and cooperation skills are mandated. Once these issues are dealt with, providing the team with the necessary resources and support from the management team will enhance the team members' level of commitment. Finally, enabling the team members to use some slack time will stimulate the feeling of freedom and autonomy, as well as decrease workload pressure. All of these factors are positively related to creativity, which on its turn will inspire organizational members in their discovery process of innovation opportunities.

It is useful to note the explorative nature of the empirical part of this study. Two shortcomings should be mentioned and can serve as impetus for further research in this area. First, the sample size is small particularly in relation to the number of independent variable which we wanted to test. This puts restrictions on robustness of the conclusions that can be drawn from the results of the regression model. Second, the sample is representative of one industry only. It would be useful to generalize the results to other industries. The sample is cross-sectional and therefore, caution is exercised in the interpretation of the results in terms of causation. With respect to the latter, we made an attempt to mitigate by allowing a broader span when defining certain questions that measure the competencies. For example, when asking about patents, and copyrights we let the time lag to be five years, thus preceding the actual innovation output. Larger data sets and refinement in development of questionnaires to measure firm organizational competencies is appropriate in order to make advancement in this important topic. Combining variables pertaining to customer, technological and organizational uncertainties are useful in extending the academic understanding in this area. In spite of the above limitations, and the study's explorative nature, we believe our findings provide some useful insights into the relationships between firm competencies and the innovative performance of firms.

Appendix Tables A1—A4

Table A1 Questionnaire items.

Product innovations
1. How many successful product innovations did your company realize in the last two years?
2. How many of the above mentioned product innovations are new to the market?
3. How many of the above mentioned product innovations are new features to already existing products?

Technological competencies
1. Your firm has patents, copyrights, registered trademarks, or registered designs
2. How many new patents, copyrights, registered trademarks, or registered designs has your firm successfully applied for in the last 5 years?
3. A person/department within your company monitors on a regular basis your product area outside your company (e.g. what other companies in the same industry are doing, or what consultancy firms are recommending) to find out whether your technology is up to date
4. If there is technology which can be used in your organization your company always tries to acquire it
5. The technical process including the involved employees and the process' outcome within your company is monitored on a regular basis by a special person/department

Customer competencies
1. Cooperation with customers regarding product innovation occurs on a regular basis
2. Your firm always relies on market research when developing a new product or product feature
3. Customers are highly important as a source of ideas for new products
4. We meet our customers on a regular basis to find out what products they will need in the future

Organizational competencies
Team cohesiveness (heavy-weight project team)
1. The project team is staffed with a core team member from each primary department
2. The project manager is a senior manager and has influence in the organization
3. The project manager is responsible for the personnel policy regarding the team
4. The project manager is responsible for the cost of the project
5. The project manager is strongly involved in the individual's performance evaluation
6. The team works autonomous with a liaison-person who directs the team in line with the overall organizational strategy

Slack time
7. Employees in your organization have some time on their own disposal in which they can choose themselves on what they work (e.g. they work on own projects, discuss ideas, or are creative)

Table A2 Descriptive statistics of all variables.

Variables	Mean	Standard deviation	Minimum	Maximum
Dependent variables				
All successful innovations	2.33	0.73	1.00	3.00
Radical innovations	0.16	0.14	0.00	0.44
Incremental innovations	0.84	0.14	0.56	1.00
Control variables				
Firm size	2935.11	4939.44	30.00	18000
Independent variables				
Customer competence				
Market research	4.48	0.85	2.00	5.00
Customer cooperation	4.26	1.13	1.00	5.00
Customer sourcing	4.44	0.58	3.00	5.00
Technological competence				
Monitoring	4.44	1.15	1.00	5.00
Transfer	4.15	1.20	1.00	5.00
Quality control	4.67	0.88	1.00	5.00
Intellectual property	1.96	0.85	1.00	3.00
Organisational competence				
Team cohesiveness	4.19	1.08	2.00	6.00
Slack	3.19	1.42	1.00	5.00

Note: The variable successful innovation is measured in categories. The minimum value of 1.00 signifies a number of 1—3 product innovations, a value of 2.00 stands for 4—10 product innovations and the maximum value of 3.00 refers to 11 and more successful product innovations. Radical and incremental are measured as the percentage of the total number of successful product innovations.

Table A3 Comparison of descriptive statistics — firms with few vs. many innovations.

Variables	Relatively small no. of innovation		Relatively large no. of innovation	
	Mean	Standard deviation	Mean	Standard deviation
Dependent variables				
All successful innovations	1.71	0.47	3.00	0.00
Radical innovations	0.16	0.17	0.15	0.11
Incremental innovations	0.84	0.17	0.85	0.11
Independent variables				
Customer competence				
Market research	4.36	1.00	4.62	0.65
Customer cooperation	3.93	1.38	4.62	0.65
Customer sourcing	4.36	0.63	4.54	0.52
Technological competence				
Monitoring	4.00	1.47	4.92	2.78
Transfer	3.72	1.38	4.62	0.77
Quality control	4.50	1.09	4.85	0.55
Intellectual property	1.43	0.51	2.54	0.78
Organisational competence				
Team cohesiveness	4.00	1.18	4.38	0.96
Slack	3.21	1.37	3.15	1.52

Note: The minimum value of 1.00 signifies a number of 1 to 3 product innovations, a value of 2.00 stands for 4—10 product innovations and the maximum value of 3.00 refers to 11 and more successful product innovation. RADINNO and INCRINNO are measured as the percentage of the total number of successful product innovations. The median which separates all respondents into two groups is set at the 14th firm and has the following values for its dependent variables: successful innovations 2.00, radical innovations 0.13, incremental innovation 0.87.

Table A4 Comparison of descriptive statistics — firms with small vs. high percentage of radical innovation.

Variables	Relatively small % of radical innovation		Relatively large % of radical innovation	
	Mean	Standard deviation	Mean	Standard deviation
Dependent variables				
All successful innovations	2.14	0.86	2.54	0.52
Radical innovations	0.04	0.06	0.29	0.08
Incremental innovations	0.96	0.56	0.71	0.08
Independent variables				
Customer competence				
Market research	4.43	0.94	4.54	0.78
Customer cooperation	3.93	1.27	4.62	0.87
Customer sourcing	4.43	0.65	4.46	0.52
Technological competence				
Monitoring	4.07	1.49	4.85	0.38
Transfer	3.79	1.31	4.54	0.97
Quality control	4.36	1.15	5.00	0.00
Intellectual property	1.79	0.80	2.15	0.90
Organisational competence				
Team cohesiveness	4.36	1.08	4.00	1.08
Slack	2.50	1.22	3.92	1.26

Note: The mean and standard deviation are reported for two different groups of firms, one group with a small percentage of radical product innovation, and one group with a large percentage. SUCCINNO is measured in categories, 1.00 referring to a number of 1—3 product innovations, 2.00 stands for 4—10 product innovations and 3.00 refers to 11 and more product innovation. Radical and incremental innovations are measured as percentage of all successful innovations.

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